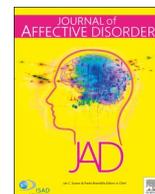




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## Research paper

## Alcohol use and mental health status during the first months of COVID-19 pandemic in Australia

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## ABSTRACT

**Background:** We aimed to estimate the population prevalence of people with changes in their usual patterns of alcohol use during the early stages of the novel coronavirus pandemic of 2020 (COVID-19) pandemic in Australia; assess the association between mental health status and changes in alcohol use during the pandemic; and examine if the associations were modified by gender and age.

**Methods:** This study was an anonymously-completed online self-report survey. Changes in alcohol use were assessed using a single fixed-choice study-specific question. Mental health was assessed using the Patient Health Questionnaire 9 and the Generalized Anxiety Disorder Scale.

**Results:** A total of 13,829 people contributed complete data and were included in the analysis. Overall, about one in five adults reported that they had been drinking more alcohol since the COVID-19 pandemic began than they used to. People were more likely to be drinking alcohol more than they used to if they had more severe symptoms of depression or anxiety. The associations between depressive and anxiety symptoms and increased alcohol use since the COVID-19 pandemic began were consistent between females and males.

**Limitations:** Online surveys are less accessible to some groups of people. The data are self-report and not diagnostic. Cross-sectional data can identify associations, not causal relationships. The study was limited to participants from Australia.

**Conclusions:** These data indicate that there is a need for public policies focused on alcohol use during the COVID-19 pandemic and the strategies should include specific consideration of the needs of people with mental health problems.

## 1. Introduction

The novel coronavirus pandemic of 2020 (COVID-19) and the restrictions implemented to contain the spread have created stressful challenges around the world (Acter et al., 2020; Pfefferbaum and North, 2020; Torales et al., 2020). Challenges include fear of contracting the virus, financial and employment losses, and government-mandated restrictions on movement and physical and social interaction.

Stress can lead to the onset and maintenance of alcohol misuse (Keyes et al., 2012). Alcohol might be used to manage the anxiety associated with adaptation and the uncertainty about the duration of restrictions. Alcohol use is strongly associated with violence, including intimate partner abuse (Foran and O'Leary, 2008). Excessive alcohol use is associated with reduced immunity to viral and bacterial infections (Barr et al., 2016; Szabo and Saha, 2015) and increases the risks of liver disease (Roerecke et al., 2019).

The first case of COVID-19 in Australia was confirmed in late January 2020. By 3 April 2020, there were 5348 confirmed cases of COVID-19 infection in Australia with 28 deaths (Department of Health, 2020). Borders were closed to all non-residents on 20 March 2020. Three days later, national restrictions were imposed, with instructions to stay at home except for certain specified activities and to maintain a distance of 1.5 m from others when away from home. Services deemed non-essential, including bars, clubs, restaurants, and gyms were closed.

There are public health concerns about the needs of vulnerable groups, including those with mental health problems, arising from pandemic-specific stress. In this study, we aimed to estimate the population prevalence of people with changes in their usual patterns of alcohol use during the early stages of the COVID-19 pandemic in Australia, assess the association between mental health status and changes in alcohol use during the pandemic, and establish whether the associations were modified by gender and age.

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## 2. Methods

### 2.1. Design

This study was an anonymously-completed, online, self-report survey during the first month of COVID-19 restrictions. The survey was built in Qualtrics Insight Platform (Qualtrics, Provo, UT). It was available from 3 April 2020 (four days after COVID-19 restrictions were implemented in Australia) to midnight on 2 May 2020. Detailed information about the design, data source, and procedure have been published elsewhere (Fisher et al., 2020).

To be eligible, respondents needed to be aged at least 18 years and living in Australia. Respondents elected to participate after having read the information sheet and answered questions about their eligibility at the beginning of the survey. As is conventional in anonymous surveys, consent is implied by completing the survey.

### 2.2. Measures

**Changes in alcohol use** were assessed using a single, fixed-choice, study-specific question: ‘Since COVID-19 I am drinking alcohol: (1) More than I used to, (2) Less than I used to, (3) About the same, (4) I don’t drink alcohol.’

**Mental health status** was assessed using the Patient Health Questionnaire 9 (PHQ-9) (Kroenke et al., 2001) for symptoms of Major Depression and the Generalized Anxiety Disorder Scale (GAD-7) (Spitzer et al., 2006) for symptoms of generalized anxiety. These scales ask respondents to endorse each symptom as “0” (not experienced) to “3” (experienced nearly every day). Aggregated responses yield a scale indicative of symptom severity. Total scores on the PHQ-9 range from 0 to 27 and on the GAD-7 from 0 to 21. On both scales, scores of 0–4 indicate that there are no symptoms, 5–9 mild symptoms, 10–14 moderate symptoms, 15–19 moderately severe symptoms, and 20 and above that symptoms are severe.

**Experience of COVID 19 and associated restrictions** were assessed using four indicators: (1) Direct experience of COVID-19 (whether the respondent had been diagnosed with or tested for COVID-19, or lived with or knew someone with COVID-19); (2) Whether a job had been lost because of COVID-19; (3) Worry about contracting COVID-19, assessed on a scale from 0 (not at all worried) to 10 (extremely worried); and (4) How badly COVID-19 restrictions had affected daily life, with scores from 0 (not at all badly) to 10 (very badly).

**Socio-demographic characteristics** of age, postcode, gender, whether born in Australia, living circumstances, and occupation were assessed using study-specific questions with fixed response options.

Data on State, urban/rural residence, and Socioeconomic Indices for Areas (SEIFA) were derived from respondent’s postcode using the most recent data from the Australian Bureau of Statistics (Australian Bureau of Statistics, 2019).

### 2.3. Statistical analysis

Data were analyzed in three stages using STATA Version 16 (StataCorp., College Station, TX). First, population prevalence rates and 95% CIs of the outcome (change in alcohol drinking) were estimated,

**Table 1**

Estimation of the proportion of the changes in alcohol drinking since COVID-19 pandemic began.

	Crude number (n) N = 13,829	Weighted prevalence*(%)	[95% CI]
More than I used to	3253	20.9	[19.7; 22.1]
Less than I used to	1185	10.5	[9.5; 11.6]
About the same	6158	43.9	[42.4; 45.4]
Don’t drink alcohol	3233	24.7	[23.3; 26.1]

\* Post-stratification weighted by: State, SEIFA decile, gender, and age.

adjusting for differences in socio-demographic characteristics between the sample and the Australian population (Australian Bureau of Statistics, 2019) using post-stratification weights (Smith, 1991).

Second, multiple logistic regression analysis was performed to examine the associations between mental health status and drinking more than usual (versus about the same/ less than I used to) taking demographic characteristics and experience of COVID-19 and the COVID-19 restrictions into account. People who did not drink alcohol were excluded from this analysis.

Third, the same multiple logistic regression analysis was performed for subgroups of gender (female and male) and age (18–34; 35–49; 50–64, and 65 years and above).

Only complete data were included in analyses.

### 2.4. Ethics approval

This study was approved by the Monash University Human Research Ethics Committee (2020–24,080–42,716).

## 3. Results

Of the 15,121 respondents who were eligible, 13,829 (91.45%) contributed complete data and were included in the analysis. Participants were from all Australian states, socioeconomic positions, and age groups, and included diverse living situations and occupations. There were some differences in the socio-demographic characteristics of this study sample compared with the Australian population. The sample had more people from the state of Victoria and fewer from New South Wales (NSW), more women and fewer men, and more in higher and fewer in lower socioeconomic positions than in the national population. Details of these characteristics and how they have been addressed in analyses have been published elsewhere (Fisher et al., 2020).

About one in five adults reported that they had been drinking more alcohol than usual since the COVID-19 pandemic began (Table 1).

A total of 10,596 people who drank alcohol were included in the multiple logistic regression analyses (Table 2). Increased alcohol consumption was associated with more severe symptoms of depression or anxiety for both women and men constantly. The positive associations between the severity of anxiety symptoms and increased alcohol use since COVID-19 restrictions were stronger in the mid-aged groups than in younger or older groups. Older people appeared to have a stronger positive association between the severity of depressive symptoms and increased alcohol consumption, but this was not statistically significant.

We did not conduct a stratified modeling analysis for people who do not identify as female or male because the number of sample size was relatively small (N = 67; of those 26.9% drinking more alcohol than usual).

## 4. Discussion

We found that about a fifth of adults living in Australia reported drinking more alcohol than usual once the COVID-19 pandemic began. However, about half of the respondents reported that their alcohol consumption had not changed or that it had reduced. Increased consumption was associated with anxiety and depression and might have

**Table 2**Adjusted odds ratios<sup>1</sup> (95% CI) of drinking alcohol more than used to since the COVID-19 pandemic began by the severity of depressive and anxiety symptoms.

	Depressive symptoms			Anxiety symptoms		
	None (PHQ-9 score 0–4)	Mild (PHQ-9 score 5–9)	Moderate, moderately severe, or severe (PHQ-9 score ≥ 10)	None (GAD-7 score 0–4)	Mild(GAD-7 score 5–9)	Moderate or severe(GAD-7 score ≥ 10)
<b>Whole sample<sup>2</sup> (N = 10,596)</b>	Ref.	1.7 [1.6; 2.0]	2.5 [2.1; 2.9]	Ref.	1.2 [1.1;1.3]	1.5 [1.3;1.7]
<b>Stratified by gender<sup>3</sup></b>						
Female (N = 7907)	Ref.	1.7 [1.5; 2.0]	2.4 [2.1; 2.8]	Ref.	1.1 [0.9;1.3]	1.5 [1.3; 1.8]
Male (N = 2643)	Ref.	1.7 [1.3; 2.2]	2.8 [2.0; 3.9]	Ref.	1.3 [1.1;1.7]	1.4[1.1;2.0]
<b>Stratified by age groups<sup>4</sup></b>						
18–34 years (N = 1741)	Ref.	1.7 [1.2; 2.3]	2.4 [1.6; 3.4]	Ref.	0.8 [0.6; 1.1]	1.1 [0.8; 1.6]
35–49 years (N = 3283)	Ref.	1.5 [1.2;1.8]	2.0 [1.6; 2.6]	Ref.	1.3 [1.1;1.6]	1.6 [1.3; 2.2]
50–64 years (N = 3539)	Ref.	1.9 [1.6; 2.5]	3.0 [2.3;3.9]	Ref.	1.2 [0.9; 1.4]	1.6 [1.2; 2.1]
65 years and above (N = 2033)	Ref.	2.1 [1.4; 2.9]	3.3 [2.1; 5.2]	Ref.	1.3 [0.9; 1.9]	1.4 [0.8; 2.4]

<sup>1</sup> Adjusted odds ratios [95% CI] were derived from multiple logistic regression models predicting drinking alcohol more than used to versus about the same/ less than used to.

<sup>2</sup> Model including both depressive and anxiety symptoms and adjusted for experiences of COVID-19 and restrictions, State, urban/rural, SEIFA quintile, gender, age group, living situation, born overseas, and job status; People who did not identify as female or male were excluded ( $n = 67$ ).

<sup>3</sup> Models including both depressive and anxiety symptoms and adjusted for experiences of COVID-19 and restrictions, State, urban/rural, SEIFA quintile, age group, living situation, born overseas, and job status.

<sup>4</sup> Models including both depressive and anxiety symptoms and adjusted for experiences of COVID-19 and restrictions, State, urban/rural, SEIFA quintile, gender, living situation, born overseas, and job status; Ref: Reference group.

been used to moderate and manage these emotional states. It is also possible that the restrictions on social interaction, including gatherings at home or in entertainment venues, might have prompted increased alcohol use at home as an alternative. Our findings are similar to those reported by Stanton et al. (2020) who reported 26.6% of a smaller cohort of 1491 adults in Australia had ‘negative changes’ in alcohol use in the first month of restrictions.

This survey of mental health and alcohol use during the COVID-19 pandemic was completed by the largest sample reported to date. Although it was a sample of self-selected respondents, we achieved a broadly representative sample with respondents from all Australian states and territories and socioeconomic positions, diverse living situations, genders and ages, including an accurate proportion (10% of the sample) of people aged at least 70 years, who are less likely to participate in online surveys. We used rigorous post-stratification weighting to permit us to extrapolate to the Australian population. We sought to reduce response bias by describing the study to potential respondents in neutral terms and making it short and easy to complete. We were able to control for the effect of COVID-19 experiences and restrictions.

We acknowledge some limitations. First, online surveys are less accessible to people who lack computer proficiency, internet access, or English literacy; these data might thus not represent their experiences. Second, the data are self-reported and not diagnostic. Alcohol consumption was assessed using a single question that did not yield detailed information about alcohol use before or during the pandemic. Third, cross-sectional data can identify associations, not causal relationships. Nevertheless, this is the best that could be achieved to generate contemporaneous evidence about relevant public health indicators in this unusually difficult global emergency. We answered the urgent call for research data to inform public health action and clinical service responses for mental health and alcohol use during the COVID-19 pandemic (Clay and Parker, 2020; Holmes et al., 2020). Although the survey was limited to Australian residents, we argue that the findings can be generalized with considerable confidence in this setting and that they have relevance for other high-income countries with similar social characteristics.

According to practice theories, alcohol use should not be treated as a single behavior (Meier et al., 2018). There is little research evidence, but the health and social harms of alcohol consumption appear to be context-dependent. In Australia, alcohol is available, accessible, and affordable (Livingston, 2014). In comparison with drinking in entertainment venues, excessive consumption of alcohol at home is

associated with higher rates of alcohol dependence, domestic violence, and other long-term adverse behavioral impacts (Ally et al., 2016).

These cross-sectional data do not allow us to make conclusions about the direction of causal relationships between mental health problems and alcohol use during the COVID-19 pandemic. They could both arise from common risk factors, including circumstantial stressors. Previous studies have not established the direction of the association between mental health problems and alcohol use (Sullivan et al., 2005). Co-occurrence of alcohol dependence and major depression and anxiety disorders is, however, reported frequently (Jane-Llopis and Matytsina, 2006). In this survey, given the brief time from the start of the COVID-19 restrictions to data collection, changed alcohol consumption is unlikely to have caused mental health problems. The major confounders, including socio-demographic factors and experiences of COVID-19 and COVID-19 restrictions, were fully controlled. Therefore, our data strongly support the interpretation that people with more severe depressive symptoms or anxiety symptoms, whether or not these were pre-existing, were more likely to increase their use of alcohol during COVID-19 restrictions compared to their usual practices.

The directions and magnitudes of the associations between the severity of depressive or anxiety symptoms and increased alcohol consumption did not vary by gender. It is usually found (in Australia and elsewhere) that men consume more alcohol than women (French et al., 2014). It is also the case that a higher prevalence of depressive and anxiety disorders is found in women than in men (Altemus et al., 2014; Parker and Brotchie, 2010). These findings are of practical importance in showing that, under COVID-19 restrictions, regardless of gender, people who have or develop depressive or anxiety symptoms are more likely to increase their alcohol consumption.

The associations between the severity of depressive/anxiety symptoms and the likelihood of increased use of alcohol during the COVID-19 restrictions were not consistent across age groups. Even though the differences among age groups were not statistically significant, older people with moderate/severe depressive symptoms appeared to be especially vulnerable to increased alcohol use. These people are more likely than others to be living alone and to be experiencing financial difficulties.

## 5. Conclusions

About one in five adults in Australia reported drinking more alcohol than usual since the COVID-19 pandemic. People with more severe symptoms of depression and anxiety were more likely to report an

increase in their alcohol consumption. These data indicate that strategies to reduce alcohol use during COVID-19 restrictions should include specific consideration of the needs of people with mental health problems. Future investigations of the effects of the change in alcohol use during the COVID-19 pandemic on physical and mental health are warranted.

### Contributors

JF, MK, KH and TT designed and conducted the survey. TT and JF conceptualized this study. HN managed the data. TT and HN conducted the statistical analysis. TT and JF wrote the draft of this paper. All authors provided the interpretation of results and critically reviewed the draft.

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The funders had no role in study design; in collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

### Declaration of Competing Interest

All authors declare that they have no conflicts of interest.

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### References

Acter, T., Uddin, N., Das, J., Akhter, A., Choudhury, T.R., Kim, S., 2020. Evolution of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as coronavirus disease 2019 (COVID-19) pandemic: a global health emergency. *Sci. Total Environ.* 730, 138996.

Ally, A.K., Lovatt, M., Meier, P.S., Brennan, A., Holmes, J., 2016. Developing a social

practice-based typology of British drinking culture in 2009–2011: implications for alcohol policy analysis. *Addiction* 111, 1568–1579.

Altemus, M., Sarvaiya, N., Neill Epperson, C., 2014. Sex differences in anxiety and depression clinical perspectives. *Front. Neuroendocrinol.* 35, 320–330.

Australian Bureau of Statistics, 2019. 3101.0 - Australian Demographic Statistics, Sep 2019.

Barr, T., Helms, C., Grant, K., Messaoudi, I., 2016. Opposing effects of alcohol on the immune system. *Prog. Neuropsychopharmacol. Biol. Psychiatry* 65, 242–251.

Clay, J.M., Parker, M.O., 2020. Alcohol use and misuse during the COVID-19 pandemic: a potential public health crisis? *Lancet Public Health* 5, e259.

Department of Health, 2020. Coronavirus (COVID-19) Current Situation and Case Numbers.

Fisher, J.R., Tran, T.D., Hammarberg, K., Sastry, J., Nguyen, H., Rowe, H., Popplestone, S., Stocker, R., Stubber, C., Kirkman, M., 2020. Mental health of people in Australia in the first month of COVID-19 restrictions: a national survey. *Med. J. Aust.* <https://www.mja.com.au/journal/2020/mental-health-people-australia-first-month-covid-19-restrictions-national-survey> [Preprint].

Foran, H.M., O'Leary, K.D., 2008. Alcohol and intimate partner violence: a meta-analytic review. *Clin. Psychol. Rev.* 28, 1222–1234.

French, D.J., Sargent-Cox, K.A., Kim, S., Anstey, K.J., 2014. Gender differences in alcohol consumption among middle-aged and older adults in Australia, the United States and Korea. *Aust. N Z J Public Health* 38, 332–339.

Holmes, E.A., O'Connor, R.C., Perry, V.H., Tracey, I., Wessely, S., Arseneault, L., Ballard, C., Christensen, H., Silver, R.C., Everall, I., 2020. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry*.

Jane-Llopis, E., Matytsina, I., 2006. Mental health and alcohol, drugs and tobacco: a review of the comorbidity between mental disorders and the use of alcohol, tobacco and illicit drugs. *Drug Alcohol Rev.* 25, 515–536.

Keyes, K., Hatzenbuehler, M., Grant, B.F., Hasin, D.S., 2012. Stress and alcohol: epidemiologic evidence. *Alcohol Res.*

Kroenke, K., Spitzer, R.L., Williams, J.B.W., 2001. The PHQ-9: validity of a brief depression severity measure. *J. Gen. Intern. Med.* 16, 606–613.

Livingston, M., 2014. Trends in non-drinking among Australian adolescents. *Addiction* 109, 922–929.

Meier, P.S., Warde, A., Holmes, J., 2018. All drinking is not equal: how a social practice theory lens could enhance public health research on alcohol and other health behaviours. *Addiction* 113, 206–213.

Parker, G., Brotchie, H., 2010. Gender differences in depression. *Int. Rev. Psychiatry* 22, 429–436.

Pfefferbaum, B., North, C.S., 2020. Mental Health and the Covid-19 Pandemic. *N. Engl. J. Med.* 383, 510–512.

Roerecke, M., Vafaei, A., Hasan, O.S.M., Chrystoja, B.R., Cruz, M., Lee, R., Neuman, M.G., Rehm, J., 2019. Alcohol consumption and risk of liver cirrhosis: a systematic review and meta-analysis. *Am. J. Gastroenterol.* 114, 1574–1586.

Smith, T.M., 1991. Post-stratification. *J. R. Stat. Soc.* 40, 315–323.

Spitzer, R.L., Kroenke, K., Williams, J.B.W., Löwe, B., 2006. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch. Intern. Med.* 166, 1092–1097.

Stanton, R., To, Q.G., Khaesi, S., Williams, S.L., Alley, S.J., Thwaite, T.L., Fenning, A.S., Vandelanotte, C., 2020. Depression, anxiety and stress during COVID-19: associations with changes in physical activity, sleep, tobacco and alcohol use in Australian adults. *Int. J. Environ. Res. Public Health* 17, 4065.

Sullivan, L.E., Fiellin, D.A., O'Connor, P.G., 2005. The prevalence and impact of alcohol problems in major depression: a systematic review. *Am. J. Med.* 118, 330–341.

Szabo, G., Saha, B., 2015. Alcohol's effect on host defense. *Alcohol Res.* 37, 159–170.

Torales, J., O'Higgins, M., Castaldelli-Maia, J.M., Ventriglio, A., 2020. The outbreak of COVID-19 coronavirus and its impact on global mental health. *Int. J. Soc. Psychiatry* 66, 317–320.